There is an outfeed or un-racking area 12 designed for the purposes of removing the completed substrates from the carriers to prepare for the next batch of substrates to be racked in area 13.

The process is a continuous conveyor system 11 where the substrates enter a spray wash and rinse booth 1 where the substrates are washed and rinsed with water. The substrates then travel via the continuous conveyor 11 to the next station 2 where the substrates are dried to remove any excess rinse materials via a warm air blower system.

The substrates travel via the continuous conveyer 11 to the next station 3 where the substrates will receive an application of a waterbased adhesive/protectant solution via aerosol spray guns. This water-based adhesive/protectant will allow for the necessary adhesion of the painted surface and protect the substrate from unwanted chemical reactions from subsequent processing. The substrates once having the adhesive/protectant layer applied will immediately move via the continuous conveyor 11 to a drying oven 4 in which the substrates will receive convection or IR heating at a temperature of 165 degrees Centigrade (325 degrees Fahrenheit) for a period of not more than 10 minutes. Upon exiting the station 3, the substrates move via the overhead continuous conveyor 11 into a temperature control tunnel 5 with the temperature controlled by IR devices. The IR devices in tunnel 5 will maintain the substrate temperature necessary for the proper subsequent application of further processes.

The temperature control of tunnel 5 is controlled via an automatic passive temperature probe which monitors the surface temperature of the substrate parts at desired intervals. The

temperature of tunnel 5 maintains the substrate surface temperature of between 130 degrees Centigrade (265 degrees Fahrenheit) and 145 degrees Centigrade (290 degrees Fahrenheit) prior to exiting tunnel 5.

The substrates move via the continuous overhead conveyer 11 and enter station 6 for the purposes of powder coating application. The substrates in station 6 are sprayed with one or more non electrostatic powder coating by a paint gun or paint guns in an automatic fashion. The application of the powder occurs while the surface temperature of the part is below the curing temperature of the powder and at a temperature between 130 degrees Centigrade (265 degrees Fahrenheit) and 145 degrees Centigrade (290 degrees Fahrenheit).

Once the substrates have been powder coated, they travel via the continuous overhead conveyor system 11 to station 7 which is a curing oven employing a mixture of IR units to bring the surface temperature of the part immediately to the curing temperature of between 165 degrees Centigrade (325 degrees Fahrenheit) and 190 degrees Centigrade (375 degrees Fahrenheit) and where the convection oven will maintain the surface and core temperature of the part for a period of between 3 minutes and 7 minutes.

The substrates travelling via the overhead continuous conveyor 11 then exit the coating system via off-feed conveyor system 15 in which case the substrates will move to un-racking area 12 or continue to tunnel 8 for further processing.

Further processing will entail the application of an additional powder coat, which is usually a clear coat or top sealer. The substrates travelling via the overhead continuous conveyor

move to tunnel 8 where the parts enter a temperature control tunnel with the temperature controlled by IR devices.

The IR devices in tunnel 8 maintain the substrate temperature necessary for the proper subsequent application of further processes. The temperature control of tunnel 8 is controlled via an automatic passive temperature probe which monitors the surface temperature of the substrate parts at desired time intervals. The temperature of tunnel 8 maintains the substrate surface temperature of between 130 degrees Centigrade (265 degrees Fahrenheit) and 145 degrees Centigrade (290 degrees Fahrenheit) prior to exiting tunnel 8. The substrates moving via the continuous overhead conveyer enter station 9 for the purposes of powder coating application in which the parts in station 9 are sprayed with one or more non electrostatic powder coating paint gun or guns in an automatic fashion.

The application of the powder occurs while the surface temperature of the part is below the curing temperature of the powder and at a temperature between 130 degrees Centigrade (265 degrees Fahrenheit) and 145 degrees Centigrade (290 degrees Fahrenheit). Once the substrates have been powder coated, they travel via the continuous overhead conveyor system 11 to station 10, which is a curing oven employing a mixture of IR units which bring the surface temperature of the part to the curing temperature of between 165 degrees Centigrade (325 degrees Fahrenheit) and 190 degrees Centigrade (375 degrees Fahrenheit) and where the convection oven maintains the surface and core temperature of the part for a period of between 3 minutes and 7 minutes. Once the part is cured in station 10, the parts travel via the overhead conveyor system 11 to un-racking area 12 where the carriers 14 are unloaded.

Figure 2 illustrates a graph indicating two alternative solutions for the curing of substrates within a curing oven after being applied with a coating of thermosetting powder coatings. A thermosetting powder requires the curing via heat. Different powders are designed to set at different temperatures. For the purposes of this illustration, the curing temperature is set at 190 degrees Centigrade (375 degrees Fahrenheit).

In figure 2, graph B indicates the time required using traditional convection oven technology art for the purposes to achieve a temperature of 190 degrees Centigrade (375 degrees Fahrenheit) for the part. The time for the surface temperature of the substrate to achieve the temperature in graph B is 12 minutes. The curing of the thermosetting powder does not occur during this 12-minute period and thus it would be beneficial to derive an alternate method to reach the prescribed surface temperature as quickly as possible prior to or upon entering the curing oven.

Graph A illustrates the method for achieving an immediate surface temperature via an IR unit placed within or just prior to the convection oven. The substrates travel on an the overhead conveyor pass between two IR units with temperature probes to monitor the surface temperature of the substrate. This ensures that the proper curing temperature is met and this immediately begins the curing process. Once the substrates have reached the prescribed curing temperature, the substrates enter the convection oven via the overhead conveyor system for a period and at a temperature necessary to cure the thermosetting powder completely.

The combination of both IR and convection ovens has produced ideal coated substrates. The convection oven provides a core temperature necessary to bind the thermosetting powder to

For example, if the VICAT is 115 degrees Centigrade (240° Fahrenheit), the primer cure would take place at about 95 degrees Centigrade (200° Fahrenheit), the powder would be cured about 95 degrees Centigrade (200° Fahrenheit).

The present process is applicable for all types of plastics. The only restriction on the process is the ability to attain a sufficient VICAT temperature.

In summary, the present method allows for a smaller apparatus, more efficiency and reduces energy consumption and provides a superior thermosetting powder coated substrate over the prior art.

While the present invention describes and discloses the preferred embodiment, it is understood that the present invention is not so restricted.